REMARKS

This amendment is responsive to the Office Action of May 15, 2007. Reconsideration and allowance of claims 1-10 are requested.

The objections to the specification and drawings are addressed

The specification has been amended to place the abstract on a separate page and to make certain clarifying amendments in the abstract.

Replacement drawing sheets 1/2 and 2/2 are provided which add textual labels to the rectangular boxes of Figures 1 and 2.

Applicants respectfully request that the amendments to the specification and the replacement drawing sheets be entered, and the objections to the specification and drawings be withdrawn in view of these amendments and replacement sheets.

The Status of the Claims

Claims 1-10 stand rejected under 35 U.S.C. § 102(e) as allegedly anticipated by Machida et al., U.S. Pat. No. 7,026,818 (hereinafter "Machida").

The Machida reference

Machida discloses parallel imaging techniques, such as SENSE, SMASH, and PILS. Machida col. 1 line 60 through col. 2 line 13. The background of the present application also describes SENSE as a pre-existing technique. Application at page 2 lines 1-32. In parallel imaging techniques such as SENSE, SMASH, or PILS, one simultaneously acquires imaging data using multiple coils but reduced encoded sampling (thus speeding up imaging), reconstructs an image from each coil to generate a folded image (including folding or aliasing or wrap-around due to the reduced sampling), and combines the folded images, taking into account the coil sensitivities of the constituent coils, to generate an unfolded image.

In the SENSE technique, one uses the multiple coils to enable reduced sampling so as to speed up the image acquisition. As noted in the present application, in other parallel imaging techniques such as SYNERGY one uses the multiple coils to acquire more data than would be acquired using a single coil so as to improve image quality rather than targeting faster image acquisition.

Machida also discloses coils (IN1-IN4) connected to switches, e.g. the SW elements of Fig. 3, and combiners (PC1, PC2) to selectively combine coil inputs into one of two outputs (OUT1, OUT2). As noted in the Office Action, a result of this configuration is that the number of output channels is less than the number of coils, e.g. by a factor of two in the embodiment illustrated in Fig.3 . The combiners (PC1, PC2) are described in Machida as adders, and each of the adders (PC1, PC2) operate to add its inputs to each other in analog form, possibly with a phase-shift to synchronize the phases (e.g., Machida col. 20 line 1 ff.) to provide the added signal to each respective output (OUT1, OUT2). Machida at col. 10 lines 65-67.

The adders of Fig. 3 operate in one of two modes, selected by the switching control signal (SC_{sig}). The mode determines which of the coils (IN1-IN4) are additively combined to form each output signal (OUT1, OUT2). For the coil arrangement of Machida Fig. 2, having a coil layout of the form:

1 2

2 4

a first mode has the combinations (1+2) and (3+4) so as to support phase encoding along the x-direction (Machida Fig. 4), and a second mode has the combinations (1+3) and (2+4) so as to support phase encoding along the z-direction (Machida Fig. 5). See Machida col. 11 lines 1-37 and at col. 12 line 53-col. 13 line 10.

The objective of this arrangement, as described at Machida at col. 3 lines 20-43, is to enable arbitrary combinations of coils for flexibility in imaging, such as combining coils to support phase encoding along a selected direction. In some embodiments, Machida contemplates larger numbers of coils in the coils array and making the selection of coil combinations based on a figure of merit such as a g-map. Machida col. 29 lines 4-40.

The approach of Machida is limited to *selecting* coil combinations. Machida does not disclose or fairly suggest weighting signals from individual channels to optimize noise characteristics or other imaging characteristic. Rather, the output of the output channels is the additive combination of the selected coils, additively combined for example by the adders (PC1, PC2) in the embodiment of Fig. 3.

The Claims Distinguish Patentably Over the References of Record

Claim 1 calls for each receiving channel being formed by *weighted superimposition* of coil signals of the individual coil elements, and *further* calls for reconstructing an MR image from the recorded MR signals, the MR signals being combined with one another *taking into account the effective spatial sensitivity profiles associated with the individual receiving channels.*

The method of claim 1 includes weighting on a per-coil basis, and defines the channels as weighted superimpositions of individual coils. Machida has no equivalent to this operation. Rather, Machida additively combines individual coil signals to define channel outputs, but without using a weighted superimposition.

Machida performs a SENSE-type reconstruction using sensitivity factors for the channels that are obtained conventionally. Machida uses a self-calibration technique, or an independent scan, to determine the sensitivity maps for the combined channels. (Machida col 27 lines 49-52; col. 28 lines 13-15).

This *per-channel weighting* disclosed in Machida corresponds to the effective spatial sensitivity profiles of claim 1 associated with the individual receiving channels. But, there is no equivalent in Machida to the *per-coil weighting* of claim 1, namely the formation of each receiving channel by weighted superimposition of coil signals of the individual coil elements. For at least this reason, Machida does not anticipate or render obvious claim 1.

Claim 2 calls for the weighting factors for the weighted superimposition of the coil signals on the individual receiving channels to be calculated such that the image noise in predeterminable image points or image areas of the reconstructed MR image is minimal.

Machida discloses selecting a coil combination to maximize SNR. As described at col. 29 lines 23-40, Machida computes a g-map (goodness factor map) for each combination of coil elements, and a coil arrangement is chosen which is optimal based on the g-map figure of merit. But, Machida never contemplates using a weighted superimposition of coil signals for each channel, much less and accordingly Machida never recognizes that one could calculate the weighting factors of such a weighted superimposition to minimize the image noise in predeterminable image points or image areas of the reconstructed MR image.

Claim 3 calls for the weighting factors for the weighted superimposition to be calculated according to the spatial sensitivity profiles of the individual coil elements and their noise behavior. This claim relates to the per-coil weighting of claim 1, for which Machida has no analog. Moreover, Machida never adjust any *weightings* to address noise issues, but rather teaches selecting coil *combinations* to optimize SNR.

Claim 4 calls for the effective spatial sensitivity profile associated with each receiving channel to be calculated from the spatial sensitivity profiles of the individual coil elements of the HF coil arrangement according to the weighting factors for the weighted superimposition of the coil signals on the respective receiving channel. Machida teaches using either the self-calibration technique or using an independent scan to obtain the sensitivity maps for the for the combined channels. There is no disclosure or fair suggestion in Machida of calculating the sensitivity profile for each channel based on the sensitivity profiles of the individual coil elements and the weighting factors used in making the weighted superimposition. Indeed, there are no weighting factors used in making a weighted superimposition in the disclosure of Machida.

Claim 9 calls for a computer program for optimizing the use of an HF coil arrangement including a plurality of coil elements for parallel MR imaging, wherein the computer program calculates weighting factors for the formation of two or more MR signals by weighted superimposition of coil signals of the individual coil elements in such a way that the image noise in predeterminable image points or image areas of an MR image reconstructed from the MR signals is minimal.

At most, Machida discloses additively combining coil signals, optionally with a phase-shift, to define two or more MR signals for parallel imaging and selecting the combination to optimize SNR. Machida does not contemplate using a weighted superimposition of coil signals, much less calculating the weighting factors of such a weighted superimposition to minimize the image noise in predeterminable image points or image areas of an MR image reconstructed from the MR signals.

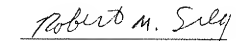
CONCLUSION

For the reasons set forth above, it is submitted that claims 1-10 distinguish patentably over the references of record and meet all statutory requirements. An early allowance of all claims is requested.

In the event that personal contact is deemed advantageous to the disposition of this case, the Examiner is requested to telephone the undersigned at (216) 861-5582.

Respectfully submitted,

FAY SHARPE LLP



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